

Advanced Communications Project

Shipboard Communications Center Modernization Network Simulation Report

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**The United States Coast Guard
Research & Development Center
1082 Shennecossett Rd.
Groton, CT 06340-6096**

By
**PRC Inc. and
VisiCom Laboratories Inc.**
Via
Volpe NTSC



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CUTTER NETWORK SIMULATION REPORT - MOD

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CUTTER COMMUNICATIONS CENTER

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Submitted to:

PRC, Inc.
1 Kendall Square
Building 200, Suite 2200
Cambridge, MA 02139

Submitted by:

VisiCom Laboratories, Incorporated
10052 Mesa Ridge Court
San Diego, CA 92121

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1.0 Scope

This document is organized as follows.

- a. Section 1.0 describes the scope of this document.
- b. Section 2.0 of this document summarizes the rationale used to select a commercially available simulation package suitable for modeling the USCG Cutter Communications Center (CCC).
- c. Section 3.0 of this document provides the parameter definitions for the USCG applicable communications modeling elements.

2.0 Simulation Tool Selection Process

Commercially available simulation packages were investigated to determine their suitability for modeling the USCG CCC. The suitability of a candidate package was based upon it meeting the operational goals and hardware platform guidelines specified in delivery order number DTRS-57-94-00102, attachment 1, section 3.2.5 ("Task 5 - Network Simulation Identification/Configuration"). The simulation package survey findings are summarized in Table 2-1. Based upon the results of the survey, COMNET III was selected due the fact that (1) it was the only package which ran on a 486/Windows or MAC environment and (2) it provided those communications elements listed in the statement of work. Note that cost was not a factor here. The communications elements defined in the statement of work are listed below:

- a. Gateways & Routers
- b. Computing Nodes
- c. Communication Interfaces
 1. LAN
 2. CSMA/CD
 4. Token ring
 5. Token bus
 6. FDDI
 7. Point-to-Point (75 bps T1)
- d. RF Media
- e. Media data link protocols.

Table 2-1 Simulation Package Evaluation Summary

Company	Product	Comments
CACI	Network II.5	Did not provide built-in communication elements required by SOW. Runs on PC
CACI	COMNET III	Met all SOW requirements
ELANIX	SystemView	Cost \$2,450, ran on PC but was more geared for simulating "discrete" communications elements (e.g., D/A converters, modulators, etc.)
COMDISCO	Banes Designer	Did not run on PC (UNIX only)
MIL3	OPNET	Best technical candidate. Costly (\$14,000). However, only runs in Workstation/UNIX environment
MathWorks	Simulink	Did not provide built-in communications elements required by SOW. Runs on PC
Simulation Systems	GSS	Did not provide built-in communications elements required by SOW. Runs on PC
Virtual Prototype	Stage VAPS 3.0	Not intended for communication system simulation

3.0 USCG Applicable Communication Elements

The COMNET III simulation tool provides the user with a template of generic communications objects such as computer groups and link objects which may be utilized in their stock form or may be tailored to the specific needs of the system being modeled. The attributes of these communications objects that can be tailored include the graphical representation of an object ("icon") including its name, and the functional attributes pertaining to the object such as data routing classes associated with a computer group object and the medium access protocol (MAC) associated with a link.

Communications objects of the computer group and link type have been modified from their original COMNET III form and tailored to represent specific communications elements present within the USCG CCC. These tailored objects and their associated parameters have been stored within COMNET III's master object library and may be readily accessed (via a pull-down menu) for inclusion in a model. The following section provides an overview of the properties that have been defined for the USCG CCC-applicable communications elements.

3.1 "End System" Communication Object Tailoring

The USCG CCC communications "end systems" listed in Table 3.1-1 were modeled by individually tailoring the COMNET III "computer group" object to match the specifics of each end system.

- a. Creation of Unique Icons.

Unique icons having descriptive names were created for the USCG CCC end systems, as illustrated in Figure 1.3-1.

- b. Functional Parameter Definitions.

In accordance with the design goal of keeping these objects as flexible as possible, no pre-definition of the functional parameters for these objects has been performed. The end user may specify non-default parameters for these objects by following the procedures contained in the COMNET III User's Guide.

Table 3.1-1 USCG CCC "End System" Modeling Objects

"End System" Objects
<ul style="list-style-type: none"> • Standard Coast Guard Workstation • DTC-II • TAC-3

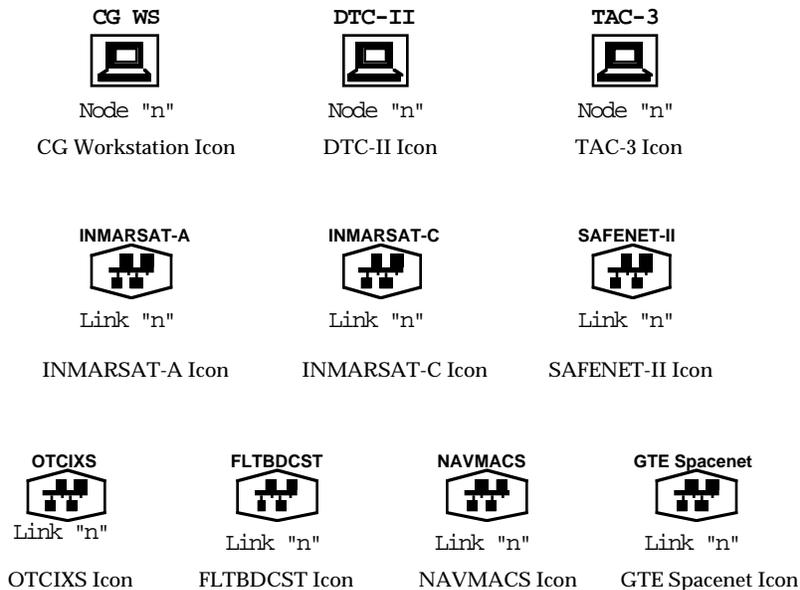


Figure 3.1-1 USCG CCC Applicable Icons

3.2 Satellite Link Object Tailoring

The USCG CCC satellite links listed in Table 3.2-1 were modeled by individually tailoring the COMNET III "link" object to match the specifics of each satellite link.

- a. Creation of Unique Icons.
 Unique icons having descriptive names were created for the USCG CCC satellite links, as illustrated in Figure 3.1-1.
- b. Functional Parameter Definitions.

Certain of the parameters associated with the satellite link objects are static in nature and could thus be pre-defined without adversely affecting the design goal of maintaining object flexibility. The pre-defined parameters for each of the satellite links are provided in Tables 3.2-2 through 3.2-7. The remainder of the satellite link parameters may be modified from their default values by the end user by following the procedures contained in the COMNET III User's Guide.

Table 3.2-1 USCG CCC Satellite Link Modeling Objects

Satellite Link Objects
<ul style="list-style-type: none"> • INMARSAT-A • INMARSAT-C • US Navy OTCIXS • US Navy FLTBDCST • US Navy NAVMACS • GTE Spacenet Circuit

Table 3.2-2 INMARSAT-A Satellite Link Object Parameters

Parameter	Real World Implementation	Model Implementation
MAC	Aloha	COMNET III ALOHA protocol
Max Satellite Link Data Rate ("Bandwidth")	9600 bps *	10kbps
ACK/NAK?	ACK/NAK with automatic repeat transmission request	COMNET III ALOHA protocol. ACK/NAK with automatic repeat transmission request

* NOTE: This data rate corresponds to that of the INMARSAT-A mobile terminals, and is the default value used by the INMARSAT-A Link modeling object (rounded to 10 kbps). If the user wishes to operate the link at the higher rate of 56 kbps, this may be achieved by changing the bandwidth value associated with the INMARSAT-A modeling object from 10 kbps to 56 kbps.

Table 3.2-3 INMARSAT-C Satellite Link Object Parameters

Parameter	Real World Implementation	Model Implementation
MAC	Aloha	COMNET III ALOHA protocol.
Max Satellite Link Data Rate ("Bandwidth")	600 bps	1 kbps
ACK/NAK?	ACK/NAK with automatic repeat transmission request *	COMNET III ALOHA protocol. ACK/NAK with automatic repeat transmission request

* NOTE: The store-and-forward characteristics associated with this link have not been modeled as a part of the INMARSAT-C modeling object. The user may implement the store-and-forward characteristic by means of time delays in the transmission of data from the message source modeling objects.

Table 3.2-4 OTCIXS Satellite Link Object Parameters

Parameter	Real World Implementation	Model Implementation
MAC	Sequence Order List-based protocol	<ul style="list-style-type: none"> • COMNET III ALOHA protocol • SOL construct not available in COMNET III, however, user may tailor Message Source objects to behave as NCS SOL
SOL Properties	SOL changes from cycle to cycle as the number of active net members changes	SOL (defined by user) is static for duration of any one simulation. SOL can only be changed (by user) between simulation runs
Max Satellite Link Data Rate ("Bandwidth")	2400 bps	3 kbps
ACK/NAK?	No ACK mechanism. Uses repetitive transmission instead	<p>Do not explicitly model the actual repetitive transmissions. Instead, model the effect of performing repetitive transmissions as a reduced data transmission rate:</p> $\text{reduced data rate} = (\text{nominal data rate})/n \text{ where } n = \# \text{ of retransmissions}$

Table 3.2-5 FLTBCST Satellite Link Object Parameters

Parameter	Real World Implementation	Model Implementation
MAC	Broadcast	Broadcast using a user defined multicast routing list
Max Satellite Link Data Rate ("Bandwidth")	16 channels @ 75 bps = 1200 bps	Minimum data rate assignable to link is 1 kbps. (Responsibility for 75 bps data rate is implemented at subscriber node's Message Source objects)
ACK/NAK?	None	None

Table 3.2-6 NAVMACS Satellite Link Object Parameters *

Parameter	Real World Implementation	Model Implementation
MAC	Modified round-robin using a Sequence Order List (SOL)	<ul style="list-style-type: none"> • COMNET III ALOHA protocol • SOL construct not available in COMNET III, however, user may tailor Message Source objects to behave as NCS SOL
SOL Properties	SOL changes from cycle to cycle as the number of active net members changes	SOL (defined by user) is static for duration of any one simulation. SOL can only be changed (by user) between simulation runs
Max Satellite Link Data Rate ("Bandwidth")	19.2 kbps	19 kbps
ACK/NAK?	ACK/NAK with automatic repeat transmission request	COMNET III ALOHA protocol. ACK/NAK with automatic repeat transmission request

* NOTE: The term "NAVMACS" as used here refers to the link properties associated with the CUDIXS/NAVMACS network.

Table 3.2-7 GTE Spacenet Satellite Link Object Parameters *

Parameter	Real World Implementation	Model Implementation
MAC	Aloha	COMNET III ALOHA protocol
Max Satellite Link Data Rate ("Bandwidth")	56 kbps	56 kbps
ACK/NAK?	ACK/NAK with automatic repeat transmission request	COMNET III ALOHA protocol. ACK/NAK with automatic repeat transmission request

* NOTE: GTE Subnet Metered Channel Services (MCS) is provided by the GTE Spacenet Satellite Link.

3.3 LAN Object Tailoring

The USCG CCC communications LAN listed in Table 3.3-1 was modeled by tailoring the COMNET III "link" object to match the specifics of the LAN.

a. **Creation of Unique Icons.**

Unique icons having descriptive names were created for the USCG CCC LAN, as illustrated in Figure 3.1-1.

b. **Functional Parameter Definitions.**

Certain of the parameters associated with the USCG CCC communications LAN are static in nature and could thus be pre-defined without adversely affecting the design goal of maintaining object flexibility. The pre-defined parameters for the LAN are provided in Table 3.3-2. The remainder of the LAN's parameters may be modified from their default values by the end user by following the procedures contained in the COMNET III User's Guide.

Table 3.3-1 USCG CCC LAN Modeling Object

LAN Object
• SAFENET-II

Table 3.3-2 SAFENET-II Object Parameters

Parameter	Real World Implementation	Model Implementation
MAC	Dual-ring token passing LAN	COMNET III token passing protocol

3.4 Creating Models with the USCG CCC Communications Objects

The COMNET III user can build simulation models of USCG CCC's using the library of USCG CCC applicable objects and the generic COMNET III objects. It is assumed that the user is familiar with the procedures for starting the COMNET III application, inserting and tailoring generic COMNET III communications objects, and saving COMNET III files. (Refer to the COMNET III User's Guide for definitions of these procedures). The purpose of this section is to illustrate the manner in which to insert USCG CCC applicable communications objects into a model. The following discussions assume that the COMNET III application is running.

3.4.1 Inserting Communications "End Systems" into a Model

Pull down the "Create" menu option from the main COMNET III menu bar and select the "Nodes" option. A submenu will appear containing a list of the possible end system communication objects available for insertion into your model. Note that the list contains both generic COMNET III objects and the USCG CCC applicable objects, as illustrated in Figure 3.4.1-1.

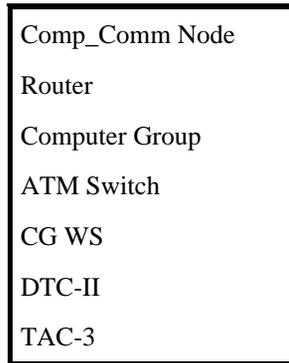


Figure 3.4.1-1 COMNET III "Nodes" SubMenu Entries

* Note: The last three items available on the "Nodes" submenu are the USCG CCC applicable end systems: Coast Guard Workstation ("CG WS"), DTC-II, and TAC-3. To enter one of these objects into your model simply select the object from the list and using your pointer device (mouse, trackball) drag the ghost image of the object to the desired position on your model and depress the appropriate control button on your pointing device. This action will insert the selected object into the model at the location to which you have pointed. As described in section 3.0 of this report, in order to maintain a high degree of flexibility, the attributes of these objects have been left in their default state. In order to modify an object's parameters, refer to the COMNET III User's Guide.

3.4.2 Inserting Satellite Communications Links and LANS into a Model

Pull down the "Create" menu option from the main COMNET III menu bar and select the "Links" option. A submenu will appear containing a list of the possible link objects available for insertion into your model. Note that the list contains both generic COMNET III objects and the USCG CCC applicable objects, as illustrated in Figure 3.4.2-1.

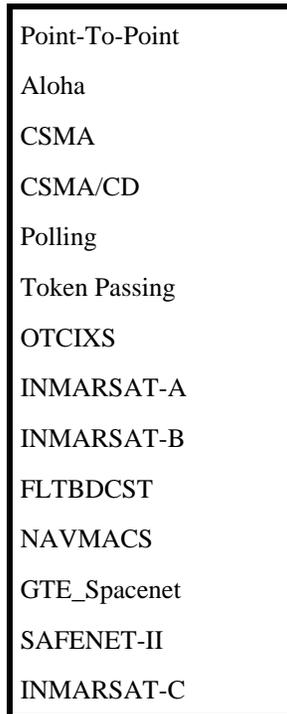


Figure 3.4.2-1 COMNET III "Links" SubMenu Entries *

* Note: The last eight items available on the "Links" submenu are the USCG CCC applicable links. (Note that although "INMARSAT-B" appears in the list it is a null object). To enter one of these objects into your model simply select the object from the list and using your pointer device (mouse, trackball) drag the ghost image of the object to the desired position on your model and depress the appropriate control button on your pointing device. This action will insert the selected object into the model at the location you have pointed to.